CDOT
Chicago Department of Transportation

Chicago Department of Transportation (CDOT) – Division of Infrastructure Management (DIM) Geotechnical Review Guidelines

August 2021

CDOT-DIM Geotechnical Review Guidelines

Private and public projects which have excavations and/or penetrations equal to or greater than 12 feet below existing grade will require, prior to starting any work, geotechnical and Office of Underground Coordination/Existing Facility Protection (OUC/EFP) reviews and approvals from Chicago Department of Transportation's (CDOT) Division of Infrastructure Management (DIM). In addition, any excavation deeper than 4 feet that extends beyond the property lines and into the public way will require OUC review and approval. The following is a partial list of items that will require both the geotechnical and OUC reviews:

A. Deep foundation members such as caissons, drilled shafts, H-piles, pipe piles, auger-cast piles, micropiles, helical piers, timber piles, dynamic compaction, etc.
B. Underpinning elements such as micropiles, hydraulically pushed piers, helical piers and any other form of underpinning.
C. Earth retention systems (ERS) that include, but not limited to, steel sheet piling, soldier piles and lagging, slurry walls, secant walls, ground improvements for ERS, rings and lagging, timber sheeting, timber boards and lagging, trench boxes and/or any other equivalent shoring systems.
D. Backfilling and/or restoration of utility vaults, vaulted sidewalks, vaulted alleys, and/or any other vaulted areas in the public way (these are special cases whereby any depth applies).

For all building projects requiring building permits, contact the Department of Buildings (DOB) to start the building permit process which may include OUC/EFP review, geotechnical review, ERS review, etc. In these cases, OUC/EFP process is the responsibility of the DOB.

For projects requiring geotechnical reviews such as vaults (regardless of proposed work depth), bridges, roadway structures, utilities, tunneling, jack and bore (regardless of proposed work depth), directional drilling, dynamic compaction, etc. contact Adam Ali (at adam.ali@cityofchicago.org or 312-742-3130) to start the geotechnical and OUC/EFP review process. The geotechnical review shall proceed concurrently with the OUC/EFP process. The start of the OUC/EFP process shall be coordinated with Adam Ali of CDOT. Both the geotechnical and OUC/EFP reviews and approvals are required prior to issuance of permit by CDOT.

The project manager shall contact Adam Ali of CDOT to schedule an intake meeting (electronic or in-person) to start the permit review process of the proposed project along with the OUC/EFP submittal. It is the responsibility of the project manager to submit complete required calculations and drawings for geotechnical review. The submitted documents shall be 100% complete, signed and sealed (with seal expiration date), and ready for construction.

In addition to the geotechnical and OUC/EFP reviews, CDOT will advise the project manager which other permits and approvals will be required such as harbor permits, bridge permits, grant of privilege approvals for installation in the city's right-of-ways (public ways), freight and trolley tunnel permits, vacations, dedications, easements, etc.

It is required that the project manager provide a complete set of drawings and reports as indicated in the CDOT-DIM Geotechnical Review Guidelines for the initial intake. Drawings must include all scope of work including, but not limited to, all excavation area limits, all structural elements, penetrations, limits of the proposed ERS on plan views and sections indicating all geometry of the ERS, length and layout of tie-backs and/or anchorpiles (if any), adjacent utilities, etc. The project manager should submit a complete set of calculations, procedures, drawings, and reports for geotechnical review to CDOT. The submittal shall include, but not limited to, ERS designs, installation procedures (i.e. tie-backs, trench boxes, caissons, jack and bore, piles, directional drilling, etc.), bearing capacity and settlement calculations from the Engineer of Record, testing procedures (if applicable), geotechnical report, etc.

Damage monitoring of the City's right-of-way (ROW) during construction by licensed surveyors may be required for the protection of adjacent facilities, utilities, and infrastructures. Prior to permit authorization, CDOT will provide damage monitoring criteria requirements (after the completion and approvals of the geotechnical and OUC/EFP reviews). Prior to the start of any work, call DIGGER at 811, two days (minimum) to locate/mark all existing facilities and utilities.

1.0 GEOTECHNICAL INVESTIGATION AND RECOMMENDATION REPORT

A. Provide finalized geotechnical report with scope of investigation (borings, tests, soils strata descriptions, design and procedures recommendations, etc.) Include all recommended foundations, ERS, excavations, backfilling, dewatering, installation procedures, etc. Report must be signed and sealed (with seal expiration date) by the Geotechnical Engineer of Record (Professional Engineer (PE)).

B. Provide adequate soil borings covering the entire area of installations. A minimum of one new soil boring at the project site is required. Larger areas of work will require a minimum of one soil boring every two city blocks or as directed otherwise.

C. Soil borings must be drilled below the bottom of the proposed element installations (caissons, piles, ERS, etc.) and excavations to support design requirements. When caissons are proposed on top and/or into bedrock, it is required to obtain core borings to sufficient depths below the proposed bottom of caissons.

D. Soil boring logs shall include top elevation of existing ground surface, ground water levels, standard penetration test (N) values, unconfined compressive strength and/or shear strength values, natural water content values, soil/rock core classifications with each strata layer identified, etc.

E. In-situ testing is recommended for the design of ERS, bearing capacity of deep foundations, and settlement/lateral movements. Testing may include, but is not limited to, pressuremeter, vane shear, cone penetrometer, and other testing required by the Geotechnical Engineer of Record.

2.0 DRAWINGS

A. Each drawing must be 100% complete and ready for CDOT review.

B. Each drawing must be signed and sealed (with seal expiration date) by an Illinois PE and/or Illinois Structural Engineer (SE) where appropriate.

C. Drawings must clearly show all excavation/penetrations (with dimensions) being performed at any stage of the construction sequence or process.

D. Each drawing shall indicate the latest submittal date(s) and revision number(s).

E. Each drawing must indicate the Deep Excavation EFP (DEEFP) number in the lower right-hand corner of the drawing.

F. Each drawing is considered a standalone sheet. Therefore, all callouts and notes must reference in detail all reference sheets/drawings (i.e. Refer to Sheet X for details/cross-section/etc., Refer to Sheet Y for general plan and elevation., etc.). The submittal package must have every single sheet/drawing adequately reference all sheets within the permit package.

G. Show only the portion of the project being requested for a permit. All other areas not part of the permit request must be crossed/shaded out and indicated as “Not for permit under this contract.” This must be done for every single drawing submitted.

H. For permit projects that have areas of work under separate permitting, indicate the EFP and/or DEEFP number) of the area previously submitted to OUC and/or Deep Ex. If submission is pending, then indicate “To be submitted for separate OUC review.”

I. A valid information retrieval (IR) must be shown. Expired IR will not be accepted. All proposed work (i.e., excavations, foundations, ERS, etc.) must be dimensioned from the right of way lines (transverse and longitudinal dimensions).
J. All drawings must be of consistent size (preferably printed/displayed as 11" x 17").
K. The general set up for the OUC plan set is: Cover Page, OUC Key Plan Sheet, followed by all drawings associated with the OUC Key Plan Sheet.

2.1 Cover Sheet

A. Provide the project name and address.
B. Provide the design company full contact information (name, address, telephone number, etc.).
C. Provide the location/vicinity map with the area of work clouded or circled including north arrow.
D. Provide the scale used for drawings.
E. Provide the scope of work description.
F. Indicate legends for symbols for existing and proposed utilities.
G. Provide 811 (Digger) information.
H. Provide the project DEEFP number.
I. Provide an index table listing all drawing/sheet numbers, drawing sheet title, revision date, and revision number.
J. Provide a brief and concise scope of work description that is being requested for permit. Scope of work must indicate/identify all areas requiring permit review, means and methods (i.e. open cuts, foundations, ERS, trench boxes, etc.), and all areas where there are any excavations/penetrations into the ground. The following example is a scope of work for the cover sheet:

Scope of Work Requested for Deep Ex and OUC Permit:
Trench box installation for 36" sewer pipe.
Open cut excavation for XYZ at locations ABC.
H-pile installation for ABC.
Etc.

2.2 Plat of Survey

A. Must provide plat of survey prepared, signed and sealed by a licensed surveyor, and dated within the last six months in the Central Business District (CBD) and within one year outside the CBD (CBD bounded by North Avenue (north limit), Halsted Street (west limit), Cermak Road (south limit), and Lake Michigan (east limit)).
B. Show existing streets, alleys, sidewalks, existing adjacent buildings, etc.
C. Indicate all vacated and easement corridors.
D. If existing utilities (gas, water, sewer, electric, telephone, telecom lines, freight and trolley tunnels, abandoned water tunnels, etc.) were obtained through the OUC IR by the surveyor, then all existing utility information shall be shown on the plat of survey. However, if OUC IR was not performed by the surveyor and existing utilities are not plotted on the plat of survey then it is required by CDOT that all indicated required utility

information must be obtained through OUC IR process by the Civil Engineer and shall be plotted on the civil existing conditions drawing.

E. OUC IR online link: https://www.chicago.gov/city/en/depts/cdot/supp_info/ouc--informationretrievalprocess.html

2.3 OUC Key Plan Sheet

A. OUC Key Plan shall comprise of the proposed site plan indicating all proposed improvements. All areas of work requiring proposed excavations and/or deep foundations (i.e. ERS, open cuts, caissons, piles, etc.) shall be circled and each circled area must indicate reference drawing number/s where complete detailed plan views and sectional details of each proposed circled area of work (including existing utilities information) are included.

B. It is recommended to have the OUC Key Plan Sheet in one sheet. However, due to the density, scope, and limits of a project, several sheets may be required. It is best to use engineering judgment on the quantity of sheets and scale of the OUC Key Plan Sheet to best depict the permitting request.

2.4 Civil Plan and Details

A. Provide a site plan indicating new and/or existing sidewalks, alleys, streets, proposed grades, etc.

B. Provide a demolition plan indicating all areas to be removed (sidewalks, alleys, streets, utility lines, utility structures, etc.).

C. Provide the existing condition plan indicating existing grade streets, sidewalks, alleys, utility lines, utility structures, etc. (refer to Section 2.2.D).

D. Provide the proposed utility plan indicating all proposed utility lines and utility structures. All new utility lines and structures shall have dimensions from street ROW lines (longitudinally and transversely at proposed work limits).

E. Provide elevations and section detail drawing(s) indicating all proposed utility profiles and utility section details.

2.5 Structural Plans

A. Provide a foundation plan indicating proposed foundations (caissons, grade beams, piles, cap footings, etc.).

B. Provide foundation details showing typical section details for caissons, piles, footings, etc.

2.6 ERS/Excavation Drawings

A. Provide locations with dimensions of ERS/excavation limits. All proposed ERS/excavation shall also be dimensioned from street ROW lines. Include all existing utilities, existing adjacent buildings, encroachments into the public way, etc.

B. Provide typical section details showing existing grade lines and elevations, top and tip elevation of proposed ERS, top and bottom of all sloped excavations. Section details

must indicate ROW/property lines, existing utility lines/utility structure, adjacent buildings, any encroachments in the public way, etc.

C. Provide elevation section views (laterally and longitudinally) showing all utilities and underground structures with lateral dimensions and depth dimensions. At a minimum, show all utilities and underground structures from the ERS face to within a lateral distance equivalent to the maximum depth of the ERS.

2.7 Maintenance of Traffic (MOT) Plans

A. Provide a plan view indicating streets, sidewalks, alleys (including utility poles), existing CTA structures, CTA bus stops, fences, barricades, canopies with dimensions from ROW lines, etc. Also, indicate portions of streets, sidewalks, and alleys to be closed and any detours with dimensions from ROW lines.

B. For additional requirements and typical details refer to CDOT regulations for construction and repair in the public way.

2.8 Trench Boxes

A. Trench boxes required for installation with excavations less than 12 feet and not requiring a direct OUC submittal must also be submitted for geotechnical review and approval prior to permit issuance by CDOT.

B. Provide detailed step-by-step installation sequence/procedure that includes all dimensions of the open trench (length, width, and depth) for trench box placement.

C. Installation sequence/procedure shall indicate immediate backfilling of the over-excavated areas/voids between the excavated trench sides and trench box with specified fine grain soil after the trench box placement and before proceeding with excavation to specified grades, utility line/structure installations, backfilling sequence, etc.

D. All excavation within the trench box shall be backfilled to street pavement subgrade level and/or to the existing grade level prior to removal of the trench box and/or sliding forward of the trench box for the next segment of installation.

2.9 Dewatering

A. Dewatering calculations and dewatering drawings must be provided from the dewatering contractor (signed and sealed with seal expiration date from a PE).

B. Design calculations for discharge volume, well point spacings, well point diameter and required length of the well points must be provided by the dewatering contractor. Submittal document shall include dewatering drawing with well points location plan and typical well point details showing existing grade, ground water level, diameter of hole, diameter of well point, length of the well point, etc.

C. Dewatering by sump and pump method is only possible if steel sheeting and/or any other impervious systems such as slurry walls, secant walls, etc. are used and driven/installed to at least 2 feet into silty clay. For soldier pile and lagging ERS in granular soils with groundwater, dewatering by sophisticated methods (well points, etc.) to at least 2 feet below the bottom of excavation level will be required.

2.10 Jack & Bore

A. All open areas around pipe openings must be properly designed to avoid any inflow of soils and groundwater into the pits. ERS elements around pipes must be designed and detailed in the drawings as well.
B. To minimize damage to the infrastructures over the jacked and bored pipe, it is required that the size of the auger head shall not be larger than ½ inch of the diameter of the casing. Bentonite slurry should be used to facilitate pipe jacking. If for any reason the auger head diameter will need to be larger than ½ inch, then cement grout shall be used to fill the gap around the jacked pipe.

2.11 Installation Procedures

A. Contractor's means and methods, installation procedures, etc. must be provided on the drawings. Any note on the drawing(s) indicating that the designer and/or engineer of record will not be responsible for the contractor's means and methods, installation procedures, etc. is not acceptable to CDOT.
B. All work in the field shall be performed in conformance with the approved drawings by CDOT. Any changes required in the field from the permitted/approved drawings will require resubmittal of revised design calculations, procedures, and revised drawings of all required changes to CDOT for review and approval prior to performing any revisions/changes in the field.

3.0 FOUNDATION DESIGN CALCULATIONS AND INSTALLATION PROCEDURES

The project manager shall submit design calculations required by CDOT. Calculations shall indicate the latest submittal date(s) and revision number(s). Hand and/or Mathcad calculations are required. If Mathcad calculations are provided then each line of calculations should include a symbolic formula, followed by the numerical formula with all numerical parameter values indicated, and then the numerical result. Computer outputs are not accepted. A general listing of required calculations is provided below for reference. Additional calculations may be required on an individual project/site specific basis. Also, the requirements specific to soil testing and analysis, as well as, foundation load testing and design parameters, may be found in the Chicago Building Code (Chapter 18 – Soils and Foundations).

A. Foundation Design Calculations and Construction Procedures
    a. Bearing Capacity: calculations for all types of foundations used [shallow (footing, mats, etc.), deep foundations (caisson, piles, etc.), and/or combination]
    b. Settlement: total and differential settlements
    c. Installation procedures
B. Underpinning of Existing Building
    a. Underpinning pier (pile) static capacity
    b. Analysis to determine if adjacent existing footing/wall are capable of withstanding anticipated pressure/stress (documentation of structural review by others)
    c. Underpinning installation procedure
C. Adjacent Structure Analysis and Protection

a. Adjacent existing footing/wall sub-grade bearing capacity/stability analysis for reduced factor of safety (FOS) due to removal of soil surcharge above and/or below existing footing subgrade levels
b. Stability Analysis
    - Allowable bearing capacity (a minimum FOS of 3.0 is required)
    - Sliding (a minimum FOS of 2.0 is required)
    - Overturning (a minimum FOS of 1.5 is required)

D. Load Tests
    a. Load tests shall be in conformance with the 2019 Chicago Building Code Section 1810.3.3.1.2.
    b. When a compression load test is performed on piles, it may be performed on a production pile; however, the production pile cannot be used as a reaction pile for the load test.
    c. When a tension load test is performed, it must be performed on a sacrificial pile.

4.0 EARTH RETENTION CALCULATIONS AND INSTALLATION PROCEDURES

4.1 Common Items

The following items are to be included with all ERS submittals. All ERS drawings and calculations must be signed and sealed (with seal expiration date) by an Illinois SE.

A. Hand calculations and/or Mathcad calculations are required. Computer outputs from design software with no hand calculations or explanations are not accepted.
B. Boring logs, field/lab test data and final geotechnical report (project site specific).
C. List all design assumptions used in the calculations, as they are introduced in sequence of computations.
D. Provide copies of relevant pages of references used in the calculations. These include all graphs, charts, or tables used in the analysis or design.
E. Provide copies of catalogue sheets, cut sheets, and/or tables of material properties, used in the structural calculations.
F. All submittals must include a sketch with listing of soil layers, soil parameters, and design water level assumed in the calculations. Specific borings which were used in establishing the design soil profiles should be identified by boring numbers as indicated on the boring logs. Note that because soil conditions vary from soil boring to soil boring over the project site, a composite and/or most critical design soil profile shall be used.
G. Calculations should include cross-sections of the ERS indicating elevations for:
    a. Top and toe of the wall
    b. Existing surrounding ground surface
    c. Bottom of the excavation
    d. Existing adjacent foundations within the zone of influence
    e. Cut slopes and set-backs
    f. Ground water level elevations
H. All formulas must be listed as they are being used in the various parts of the calculations.
I. Include all calculation steps that are a normal part of an actual hand solution whether or not a computer-assisted analysis/design was used. Computer output that is written by

hand does not classify as "hand calculations" and will not be accepted. Also, do not submit previously submitted calculations from a similar project as part of or a substitute for the new project calculations.

J. Construction and/or building surcharge should be actual loading conditions planned by the contractor (crane loading included) or a minimum traffic surcharge of 240 psf.
    a. The building and crane surcharge shall be calculated from the bottom of the loaded foundation and applied to the tip of the ERS.
    b. The traffic surcharge shall be applied from existing grade to the bottom of the ERS.

K. ERS drawings must include plan views and cross-sections which are consistent with the final designs. Sufficient cross-sections must be provided indicating top of grade, cutback slopes, excavation contour lines, adjacent buildings, sidewalks, alleys, roadways, and all lateral utilities within the zone of influence (within 2.0 times the excavation depth from grade). Dimensions from the ERS to all utilities must be shown.

L. Groundwater control plan section details and dewatering calculations prepared by an Illinois PE must be submitted for review in all cases where wells/wellpoints and/or other type of dewatering methods are necessary to maintain a water-free, stable excavation.

M. ERS must include sequence of work (i.e. pre-holing for verifying existing foundation(s), pre-trenching for the removal of existing obstruction(s), backfilling with suitable material to grade, and ERS installation). Include detailed step-by-step sequence for excavation and installation of bracings, backfilling, and removal of bracings all conforming with the staged design calculations.

N. Provide separate calculations for active, passive and surcharge pressures at: grade, ground water level, excavation level, the upper and lower interface of each soil strata layer and to at least the tip of the proposed ERS.

O. Provide separate active, passive, hydrostatic, surcharge, and net pressure diagrams (indicating all numerical values). The pressure diagrams should be used for the design of waler loads, ERS sizing, and for the required length of the ERS. Pressure diagrams with numerical values shall be plotted to reasonable size for illustration. The pressure diagrams shall be split into triangular and rectangular units. Identify units by letters or numbers for use in calculations.

P. In cases where a theoretical negative or small positive active earth pressures are predicted through clay strata, a minimum active earth pressure of $0.25\gamma z$ should be used where "γz" is the total overburden pressure at depth z.

Q. Active pressure in clay is determined using equations: $\gamma H - 2c$ or $0.25\gamma H$, where γH is the total earth pressure at depth H. The higher value from the equations shall be used for design of the ERS.

R. For the design of soldier piles and lagging walls, no passive pressure shall be considered from existing ground surface grade in front of the wall to a depth of 1.0 x D (diameter of shaft or width of pile flange) in granular soils and 1.5 x D in cohesive soils.

S. All new proposed dockwall/riverwall sheeting shall be designed considering dredge line elevations in the Chicago River established by the U.S. Army Corps of Engineers.

T. All permanent retaining walls and dock walls shall be designed for both the short term (undrained) condition and long term (drained) condition. For the design of short-term condition only the shear strength (C) value shall be considered in clay layers and for the design of long-term condition, only the angle of internal friction (ϕ) value shall be used in clay layers.

4.2 Earth Retention System (ERS) Items – General

The ERS submittal must include calculations for the design of all vertical wall components and for all bracing components. For example, depending on the system selected, this may include design for:

A. Sheet piles, soldier piles and lagging (timber, steel plate, etc.), timber sheeting, secant piles, slurry walls, etc.
B. Walers, struts, rakers, kicker blocks, anchors, connections, and temporary earth berms.
C. Utility supports for existing infrastructure. All utility support design calculations and utility support drawings shall be submitted to all affected OUC members, whose utilities will require protection, for their review, approval, and coordination prior to performing any work.
D. Use of proprietary systems (i.e. trench boxes or slide rail shoring) requires that an Illinois SE confirm that the systems components are satisfactory for site-specific conditions with supporting calculations. Manufacturers or suppliers cut sheets must be submitted, listing serial numbers of frames or boxes proposed for use on the project. These cut sheets must be signed and sealed (with seal expiration date) from an Illinois SE.
E. ERS in the City's ROW shall be cut off 4 feet below grade and left in place.
F. ERS not within City's ROW may be removed if all affected adjacent utility owners approve the removal. Required approval documentation must be provided in the Deep Ex Review Package submittal.

4.3 Items Specific to Cantilever Wall Analysis/Design

In addition to Section 4.1 and Section 4.2, the following must be included:

A. Provide a stepwise calculation of lateral pressure distribution. Provide calculations for pressures at every soil strata change of state (e.g. stratum boundaries excavation depth, ground water level, adjacent foundation load as it varies with depth, etc.).
B. Plot lateral pressures (with numerical values indicated) on diagram to reasonable size for illustration. Split diagram into reasonable triangular and rectangular units. Identify units by letter or number for use in calculations. Account for all components of load (soil, water, and surcharge).
C. Provide moment calculations based on pressure diagram(s), solving for wall embedment depth required for rotational equilibrium (FOS = 1.0) about the toe. Find zero shear and maximum moment to size the ERS. Provide calculations for the anticipated deflection of the proposed ERS and adjacent ground surface settlement.
D. Provide additional embedment length to establish safety factor or margin of safety vs. rotational failure about the toe. Any of the generally recognized methods of determining design embedment depth may be used. A minimum FOS of 1.5 is required in all cases

when the ERS is utilized as a temporary structure. A greater FOS may be required when the proposed ERS is used as a permanent structure.

E. Provide analysis of structural wall deflection and ground deformation required to mobilize passive resistance. The support assumption for structural deflection should be consistent with Figure 6-1 of the U.S. Army Corps of Engineers EM 1110-2504 "Design of Sheet Piles Walls."
F. A check of base stability should be made using generally accepted methods. A minimum allowable FOS of 1.5 is required.

4.4 Items Specific to Single Level Braced or Anchored Walls

In addition to Section 4.1 thru Section 4.3, the following must be included:

A. The free-earth support method should be used as the basis of design. No moment reduction due to flexibility of the wall should be assumed.
B. Provide calculations for earth pressure at brace or anchor level.
C. Provide calculations for the ERS wall depth of embedment for rotational equilibrium about the brace/anchor level for a FOS of 1.0. Provide calculations for waler load, point of zero shear, and maximum moment for sizing ERS. Provide additional calculations for the required length of the ERS wall for a minimum FOS of 1.5. A minimum FOS of 1.5 is required in all cases when the ERS is utilized as a temporary structure. A greater FOS may be required when the proposed ERS is used as a permanent structure.
D. Provide calculations for the design of bracings (walers, struts, connections, etc.). Provide calculations for the size of the ERS wall considering maximum moments.
E. Provide calculations for the anticipated deflection of the proposed ERS and adjacent ground surface settlement. The assumption for structural deflection should be consistent with Figure 6-2 of U.S. Army Corps of Engineers EM 1110-2504 "Design of Sheet Piles Walls."

4.5 Items Specific to Walls with Two or more Levels of Bracing

In addition to Section 4.1 and Section 4.2, the following must be included:

A. Provide analysis for cantilever and single brace stages (see Sections 4.3 and 4.4) and final depth of excavation stages.
B. Use generally recognized apparent earth pressure envelopes for determining multi-tier strut loads, do not reduce strut or anchor loads to account for temporary conditions. Naval Facilities Engineering Command (NAVFAC) Design Manual 7.02 Figure 26 can be used for the design of shoring and waler/strut loads for excavation to the bottom of the shoring system. When excavation is in soft clays, Figure 26 "Case (b)" may be used. When excavation is in stiff clays, Figure 26 "Case (c)" may be used.
C. Provide base stability analysis for partial and full depth of cut, as needed, to final critical correlation. A minimum FOS of 1.5 is required.
D. An estimate of adjacent ground movement should be made (Clough's Method or industry accepted alternate methods) accounting for stiffness of proposed wall (FOS for basal heave, number of bracing levels, depth of excavation, etc.).
E. When analyzing overall stability, do not include friction between the wall and retained soil as contributing to stability of the system.
F. Provide design for all bracing component (walers, struts, rakers, connections, etc.)

4.6 Bracing

In addition to Sections 4.1, 4.2, 4.4, and 4.5 and any other appropriate bracing analysis, the following must be included:

A. Ground anchor (tieback, H-pile, etc.) design shall include both the unbonded and bonded lengths calculations with related sketches; testing procedures (proof, performance, and creep), and production anchor installation procedure.
B. Provide design of all bracing components (walers, struts, rakers, connections, etc.).
C. Provide structural design of stiffeners, connections, support brackets, etc. Check compact and non-compact sections.

4.7 Global Stability Analysis

The overall global stability of the proposed ERS shall be verified independently when required. The global stability analysis and calculations must be provided by the Geotechnical Engineer of Record.

The analysis should include computer generated analysis input and output data sheets considering numerous slip circle failure planes. Indicate FOS on each slip circle failure plane. Provide a diagram and design calculations for the slip circle failure plane with the lowest FOS. The slip circle failure plane diagram must be drawn to an enlarged scale for CDOT to be able to verify the slip circle slice dimensions, slice angles, slice overturning and resisting moment, overall factor of safety of the proposed excavation design slopes, etc. Indicate each soil strata layer, soil strata layer design parameters, numbered slices, grade elevation, as well as top and tip elevations of the ERS (when used). Additional calculations of driving and resisting moments through individual slip circle failure plane slice(s) shall be provided.

5.0 DEFLECTION CRITERIA

All the following deflection requirements shall be met for ERS in the City of Chicago unless specified otherwise:

A. The maximum deflection of a permanent ERS shall be 1% H (H denotes the retained height) but not greater than 1 inch.
B. The maximum deflection of a temporary ERS shall be 1.5% H (H denotes the retained height) but not greater than 2 inches.
C. When the excavation (temporary or permanent) is within 1:1 (Vertical (V):Horizontal (H)) of an adjacent structure (i.e. bridge/building shallow foundation) the deflection of the ERS shall be limited to ¼ inch.
D. When the excavation (temporary or permanent) is within 1:1.5 (V:H) of an adjacent structure (i.e. bridge/building shallow foundation) the deflection of the ERS shall be limited to ½ inch.
E. When the excavation (temporary or permanent) is within 1:2 (V:H) of an adjacent structure (i.e. bridge/building shallow foundation) the deflection of the ERS shall be limited to 1 inch.

F. For ERS (temporary or permanent) that is within 1:1.5 (V:H) of adjacent water, sewer, and/or gas utilities, ERS deflections exceeding 0.25 inches will require a written approval for the submitted ERS design and deflections from the water, sewer, and/or gas utility owner(s).

6.0 OPEN CUT EXCAVATION

All open cut excavations up to 4 feet in depth shall be sloped at 1:1 (H:V) or shored and all excavations greater than 4 feet in depth shall be sloped at a minimum of 1.5:1 (H:V) or shored.

7.0 EXISTING VAULTS

Existing standalone vaults with no access into the vault from any private property or building will require CDOT geotechnical review when the scope of work involves backfilling and/or roof replacement of the vaulted sidewalks, vaulted alleys, and/or any other vaulted areas in the public way. For existing vaults in the public way with access into the vault from adjacent private property or adjacent building will require a DOB permit/review.

7.1 Backfilling of Existing Vaults and Restoration

Contractor and/or engineer shall provide detailed step-by-step procedures and sequence for backfilling and restoration to CDOT for review and approval. The procedures and sequence may involve, but not limited to design and installation of shoring within the vault walls, vault roof removal, backfilling of vault space by flowable fill and/or any other approved backfill materials by CDOT, restorations, etc.

For backfilling of an existing vault in the public way, which is adjacent and accessible from the building (on private property), refer to the CDOT Standard Detail A-3-3. For design calculations for shoring system requirements, refer to Section 4.0.

7.2 Existing Vault Roof Replacement

Contractor and/or engineer shall provide detailed step-by-step procedures and sequence for restoration/replacement to CDOT for review and approval. The procedures and sequence may involve, but not limited to, design and installation of a shoring system within the existing vault walls; removal, replacement, and restoration of the vault roof; and any installed shoring removal. Design calculations for the shoring system will be required, refer to Section 4.0.

8.0 DEEP EX PERMIT PROCESS

Deep Ex permit process utilizes the program, ProjectDox, to track, monitor, and document the permit process step-by-step. ProjectDox is also utilized for document management, uploads, and retrievals pertaining to the project being reviewed for permitting. All documents submitted must be QA/QC by the applicant team prior to submitting to CDOT. All uploads into ProjectDox are in PDF format.

A ProjectDox account will be created for a user (applicant project manager) who will act as the CDOT point of contact and project manager responsible for the permit. It is the project manager's responsibility to ensure all instructions, guidelines, and documents are followed in compliance and coordinated with the permit team.

OUC review will expire six months from the "OUC Due Date" (determined by the OUC once the OUC application is received) within the area bounded by North Avenue, Halsted Street, Cermak Road, and Lake Michigan. Outside these mentioned limits, the OUC review will expire one year from the "OUC Due Date." An OUC expiration results in a complete resubmittal of the project and restart of the permit process.

CDOT is not responsible for construction timelines and applicant team management. The permit process, applicant team management, and construction schedule are the responsibility of the applicant team.

9.0 COT-DIM DEEP EX PERMIT FEE SYSTEM

The Chicago Department of Transportation (CDOT), Division of Infrastructure Management (DIM), has a Deep Excavation Review and Permit Fee System as per Municipal Code of Chicago (MCC) § 2-120-300(e). This fee system will include a non-expedited Office of Underground Coordination (OUC) review and a CDOT Deep Excavation review.

The CDOT Deep Excavation Review and Permit Fees are non-negotiable and will be as follows:

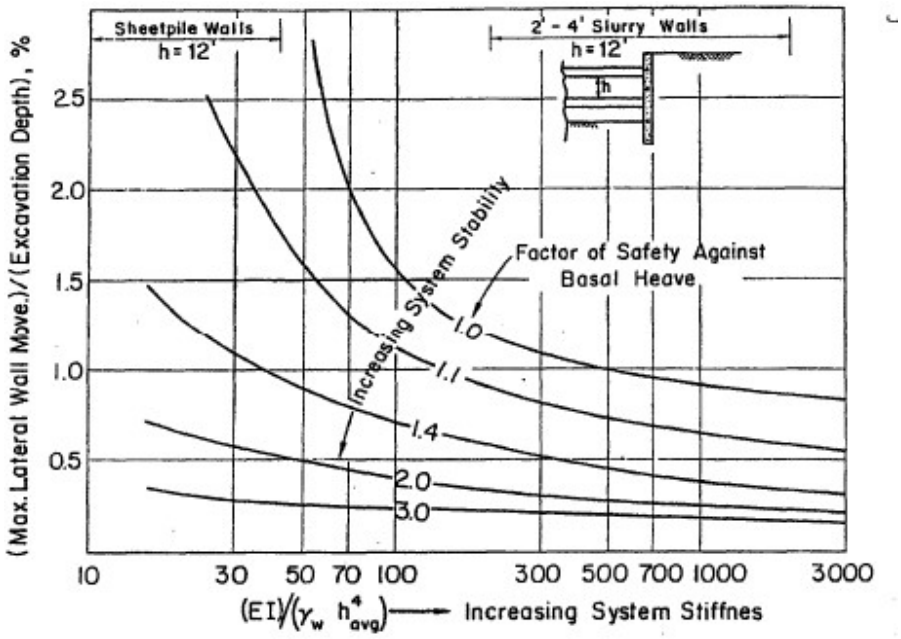
- $1,500.00 Deep Excavation Permit Application Fee
    - This fee includes the initial permit drawings review, submittal for OUC review, and one review cycle of a "Deep Ex Review Package" by Deep Excavation.
    - This fee is subject to project submission limits based on density and scope of permitting decided and agreed upon by CDOT-DIM Deep Excavation.
- $1,500.00 Deep Excavation Damage Monitoring and Inspections Fee

The mentioned fees are independent and do not include any other fees that may be required such as, but not limited to, public-way opening fees, public-way closure fees, expeditated review fees, etc.

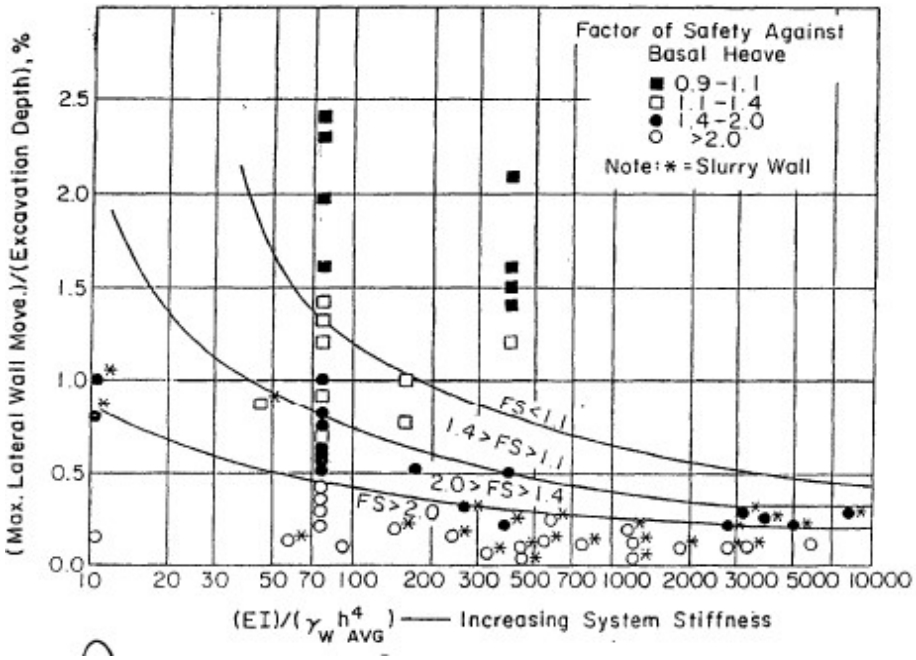
The Deep Excavation Damage Monitoring and Inspections Fee is required on a per permit basis determined by, and at the discretion of CDOT-DIM Deep Excavation.

City of Chicago departments, State Agencies, and Federal Agencies will not be subject to the Deep Excavation Review and Permit Fee System. All other permit applicants requiring a Deep Excavation review and permit will be required to pay the fees mentioned herein, no exceptions will be granted.

REFERENCE FIGURES

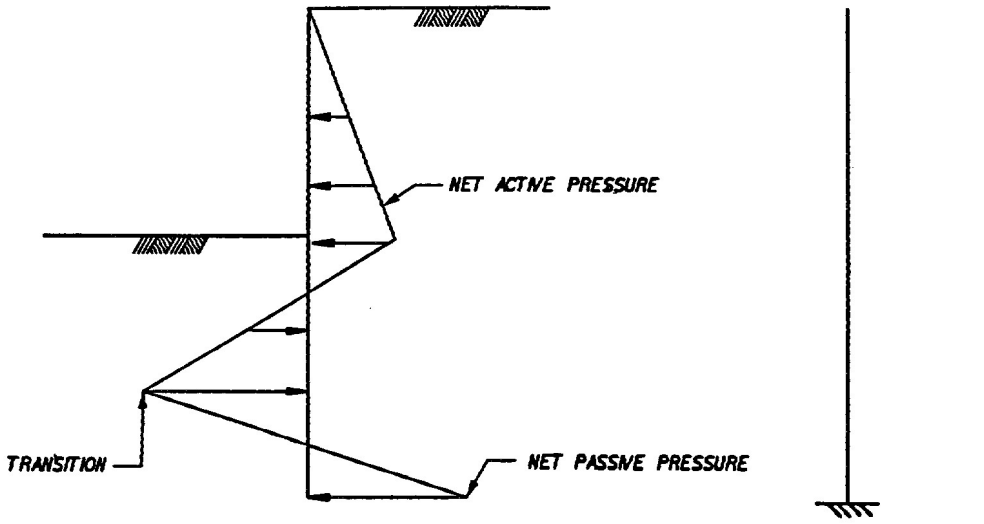


Theoretical Relationship Between Maximum Lateral Wall Movement, FOS Against Basal Heave, and System Stiffness*

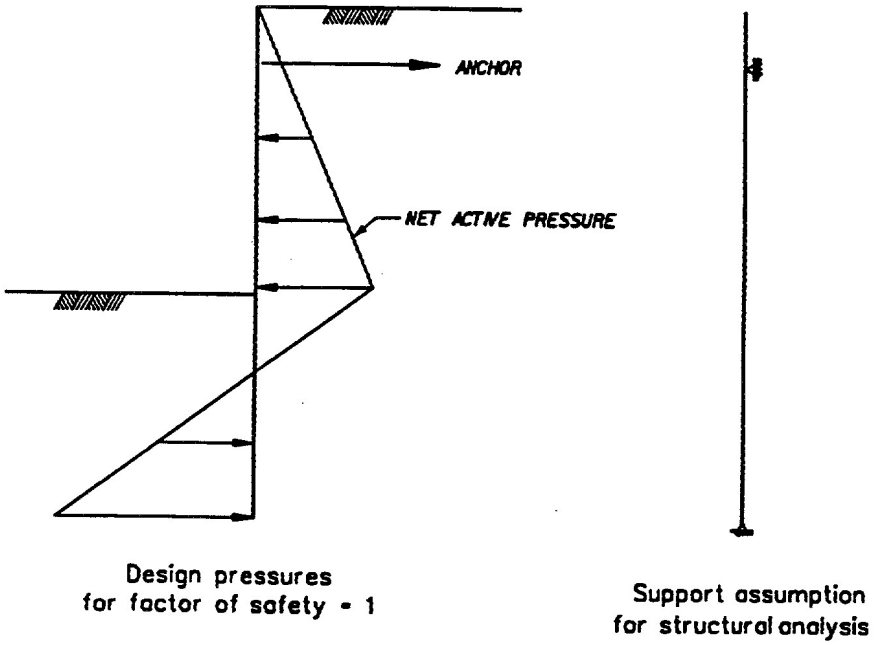


Comparison of Field Data and Theoretical Trends for Anticipated Movements*

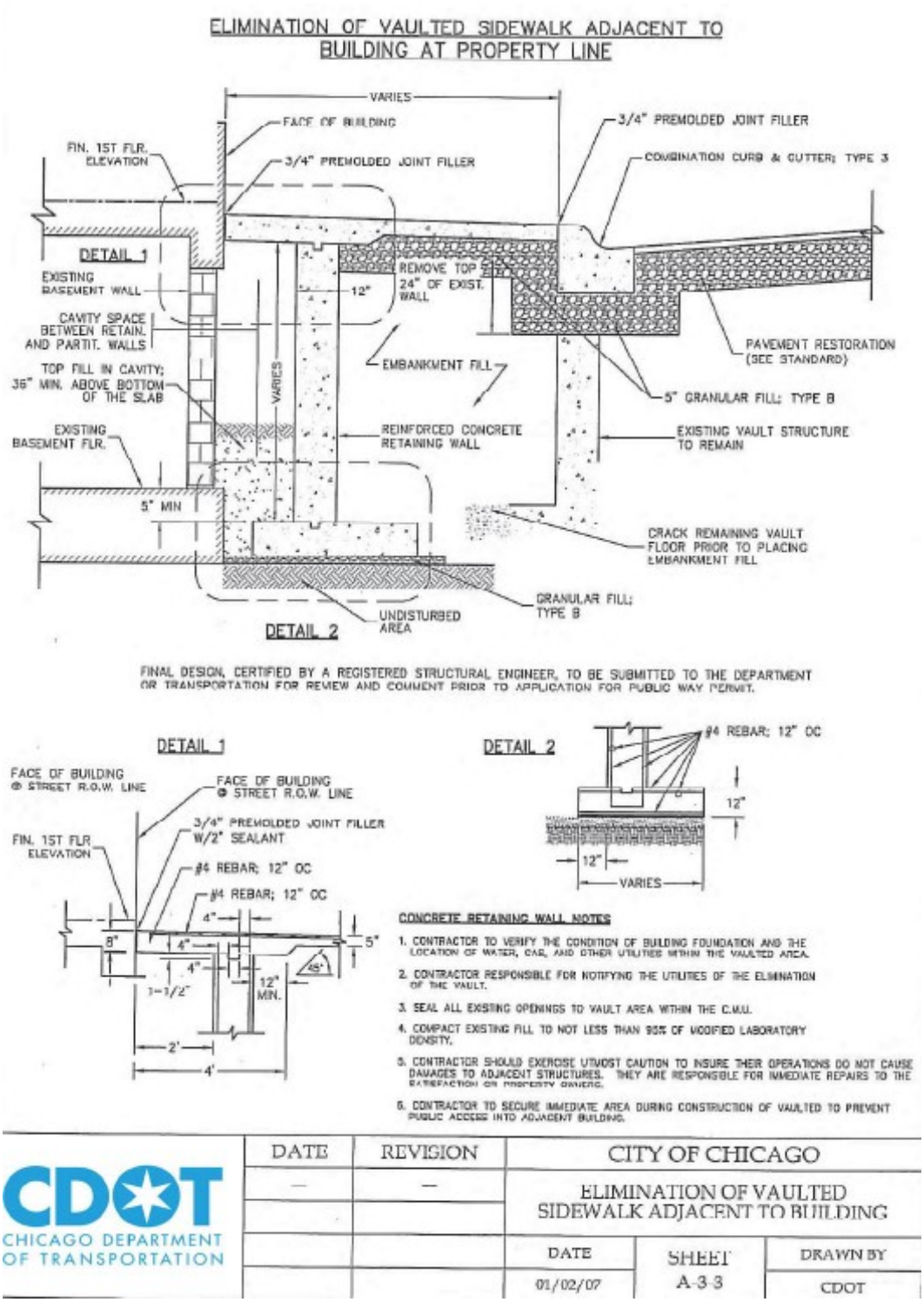
*Published research documents by Clough and other researchers.



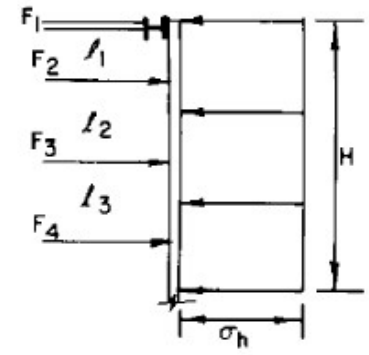
U.S. Army Corps of Engineers EM 1110-2504 Figure 6-1
Pressures and Supports for Structural Design of Cantilever Walls.



U.S. Army Corps of Engineers EM 1110-2504 Figure 6-2
Pressures and Supports for Structural Design of Anchored Walls.



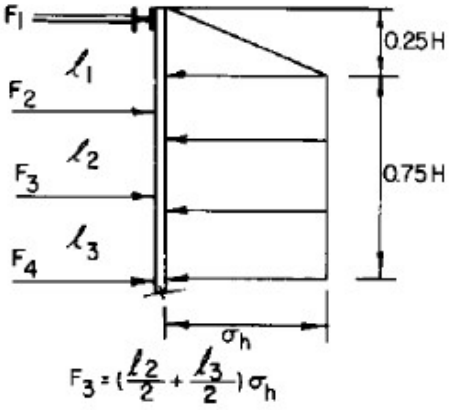
CDOT Standard Detail A-3-3
Elimination of Vaulted Sidewalk Adjacent to Building at Property Line



(a) SAND

$\sigma_h = 0.65\ K_A \cdot \gamma H$

WHERE $K_A = TAN^2(45-\phi/2)$



ASSUME HINGES AT STRUT LOCATIONS FOR CALCULATING STRUT FORCES

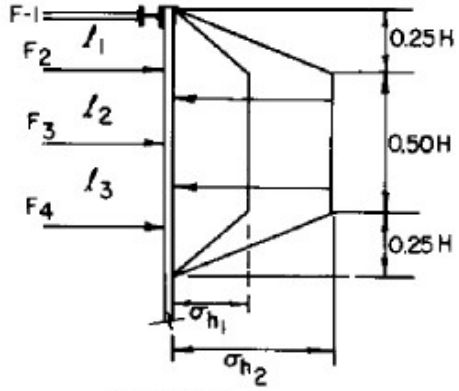
(b) SOFT TO MEDIUM CLAY
(N_o>6)

For clays base the selection on
$N_o = \gamma H/c$

$\sigma_h = K_A \cdot \gamma \cdot H$

$K_A = 1 - m\frac{4c}{\gamma H}$;
m = 1 except where cut is underlain by deep soft normally consolidated clay, then m = $0.4F_{SB}$

See Figure 28 for Factor of Safety against bottom instability, (F_{SB}): $1 \leq F_{SB} \leq 1.5$



(c) STIFF CLAY
(N_o<4)
For $4<N_o<6$, use larger of diagrams (b) and (c).
$\sigma_{h1} = 0.2\gamma H$; $\sigma_{h2} = 0.4\gamma H$
Use lower value when movements are minimal and short construction period.

NAVFAC DM 7.02 Figure 26
Pressure Distribution for Brace Loads in Internally Braced Flexible Wall